**Objectives of Heat Treatments** 

**Heat Treatment** is the *controlled heating and cooling of metals to alter their physical and mechanical properties without changing the product shape*. Heat treatment is sometimes done inadvertently due to manufacturing processes that either heat or cool the metal such as welding or forming.

Heat Treatment is often associated with *increasing the strength of material*, but it can also be used to *alter certain manufacturability* objectives such as improve machining, improve formability, restore ductility after a cold working operation. Thus it is a very enabling manufacturing process that can not only help other manufacturing process, but can also improve product performance by increasing strength or other desirable characteristics. Steels are particularly suitable for heat treatment, since they respond well to heat treatment and the commercial use of steels exceeds that of any other material. Steels are heat treated for one of the following reasons:

Softening

Hardening

Material Modification

**Common Heat Treatments** 

**Softening**: Softening is done *to reduce strength or hardness*, *remove residual stresses*, *improve toughness*s, *restore ductility*, *refine grain size* or *change the electromagnetic properties of the steel*.

Restoring ductility or removing residual stresses is a necessary operation when a large amount of cold working is to be performed, such as in a cold-rolling operation or wiredrawing. [Annealing](http://introtech1117.wikispaces.com/file/softening/annealing.cfm) — full Process, spheroidizing, normalizing and [tempering](http://introtech1117.wikispaces.com/file/softening/tempering.cfm) — austempering, martempering are the principal ways by which steel is softened.

**Hardening**: Hardening of steels is done *to increase the strength and wear properties.* One of the pre-requisites for hardening is *sufficient carbon and alloy content*. If there is sufficient Carbon content then the steel can be [directly hardened](http://introtech1117.wikispaces.com/file/hardening/direct.cfm). Otherwise the surface of the part has to be Carbon enriched using some [diffusion treatment hardening](http://introtech1117.wikispaces.com/file/hardening/diffusion.cfm) techniques.

**Material Modification**: Heat treatment is used to modify properties of materials in addition to hardening and softening. These processes modify the behavior of the steels in a beneficial manner to maximize service life, e.g., [stress relieving](http://introtech1117.wikispaces.com/file/matl_modify/stress_relieving.cfm), or strength properties, e.g., [cryogenic treatment](http://introtech1117.wikispaces.com/file/matl_modify/cryogenic.cfm), or some other desirable properties, e.g., [spring aging](http://introtech1117.wikispaces.com/file/matl_modify/spring_aging.cfm).

We will be concentrating on Hardening for this lesson.